Space Weather Technical Forecast

Issued on Thursday, 05 September 2024 at 13:08 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: M-flares expected, chance of X-flares. Slight but increasing chance of S1/Minor Radiation Storms.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Activity has been Moderate over the past 24 hours with a number of low level M-flares, peaking at M2.8 at 05/0856 UTC from AR3807 on the west limb. There are currently seven sunspot regions on the visible disc. AR3806 in the southwest is the largest and most complex region on the disc, with a large number of mostly small spots, including a couple of small delta spots. It is now starting to merge with AR3808 behind, however. AR3807 is now rotating off the southwest limb, so it is now becoming impossible to analyse but there are hints of growth. AR3813 in the southeast appears to have a fairly straightforward magnetic structure, as does the unnumbered region following it, although this is still suffering from foreshortening near the limb which makes it difficult to classify. Remaining regions are smaller and mostly stable.
No Earth-directed CMEs were observed in the last 24 hours, with a halo CME observed in coronagraph imagery assessed as far sided.

Solar Wind / Geomagnetic Activity: The solar wind as measured by ACE and DSCOVR at L1 showed CME effects gradually waning. The wind speed was mostly slightly elevated, varying between 370-470 km/s. Density was initially above average, peaking near 27 ppcc, before easing to average. The Interplanetary Magnetic Field, Bt, was initially strong with a peak of 23 nT, but gradually eased to be mostly moderate. The north-south component, Bz, was mostly northward directed, initially moderately but later weakly so. Phi angle was mostly negative (towards the Sun) with some brief variations. Geomagnetic activity was initially Unsettled to Active (Kp 3-4), easing to become Quiet (Kp 1-2).

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux observed by GOES18 is gradually easing after the response to the M5.5 flare on 01 Sep. The 24 hour peak was 5 pfu at 04/1210 UTC. High energy electron flux (greater than 2MeV) observed at GOES16 peaked at high levels during the diurnal cycle, reaching 1310 pfu at 04/1545 UTC. The corresponding 24-hour fluence showed a rising trend before levelling off. However, it remained well below the Active threshold, with 2.64e7 integrated pfu observed at 05/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate activity is expected with a chance of isolated X-flares. The risk decreases very slightly on Day 3 (07 Sep) as AR3807 rotates well over the west limb.

Solar Wind / Geomagnetic Activity: Recent CME effects from the 01 Sep CME are now declining, with no further CMEs currently expected to arrive at Earth. The HSS associated with CH65/+ in the northern hemisphere may bring elevated wind speeds on Day 3 or perhaps into Day 4 (07-08 Sep).
On the whole, geomagnetic activity is expected to be largely Quiet to Unsettled (Kp 1-3), perhaps reaching Active (Kp 4) with a slight chance of G1/Minor Storms (Kp 5) on Day 3 into Day 4 should a connection with the HSS from CH65/+ occur.

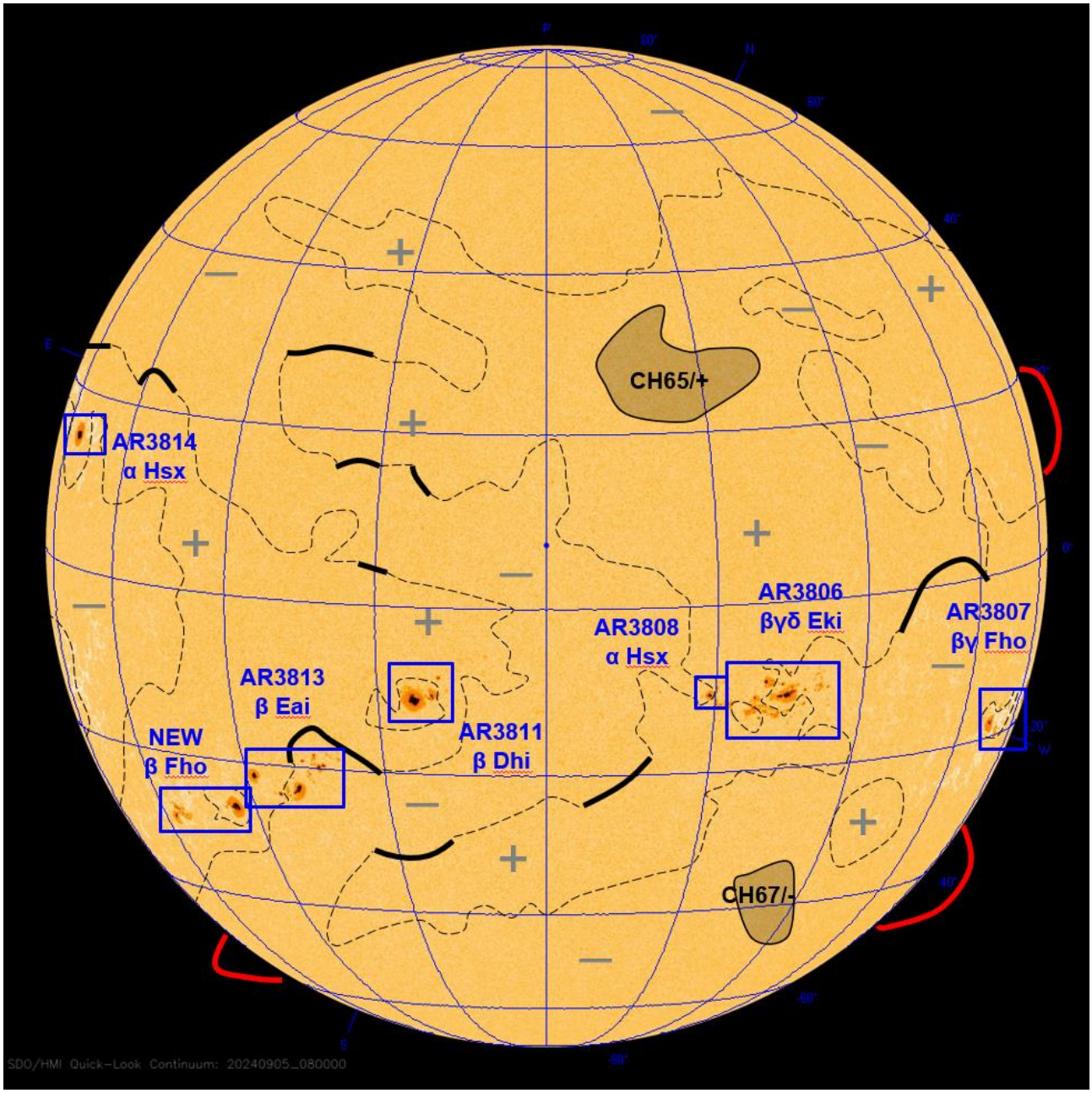
Energetic Particles / Solar Radiation: High energy proton flux is above background levels, but below the S1/Minor Radiation Storm threshold. There is a slight but increasing chance of exceeding S1 in the coming days. High energy electron flux is expected to remain at background

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

to moderate levels, perhaps rising late in the period following any HSS effects. There is a slight chance of fluence reaching the Active threshold by the end of the period.

Figure 1. Solar Analysis Valid 05/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Geomagnetic Storms:

Recent CME effects from the large eruption off the southeast limb on 01 Sep are now declining, with no further CMEs currently expected to arrive at Earth.

Two coronal holes are in the western disc. CH67/- is well to the south and with Earth north of the solar equator it is not expected to influence the solar wind at Earth. The HSS associated with CH65/+ in the northern hemisphere may bring elevated wind speeds on Day 3 or perhaps into Day 4 (07-08 Sep). This coronal hole on the previous rotation was in a slightly different location, and the solar wind was contaminated by CME arrivals, so persistence is not a particularly helpful guide here. However, the coronal hole being positive it is more likely to give a slight geomagnetic response at Earth at this time of year. MOSWOC Enlil is currently significantly overestimating the wind speed, modelling a broad and strong coronal hole which does not exist.

On the whole, geomagnetic activity is expected to be largely Quiet to Unsettled (Kp 1-3), perhaps reaching Active (Kp 4) with a slight chance of G1/Minor Storms (Kp 5) on Day 3 into Day 4 should a connection with the HSS from CH65/+ occur.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	15	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

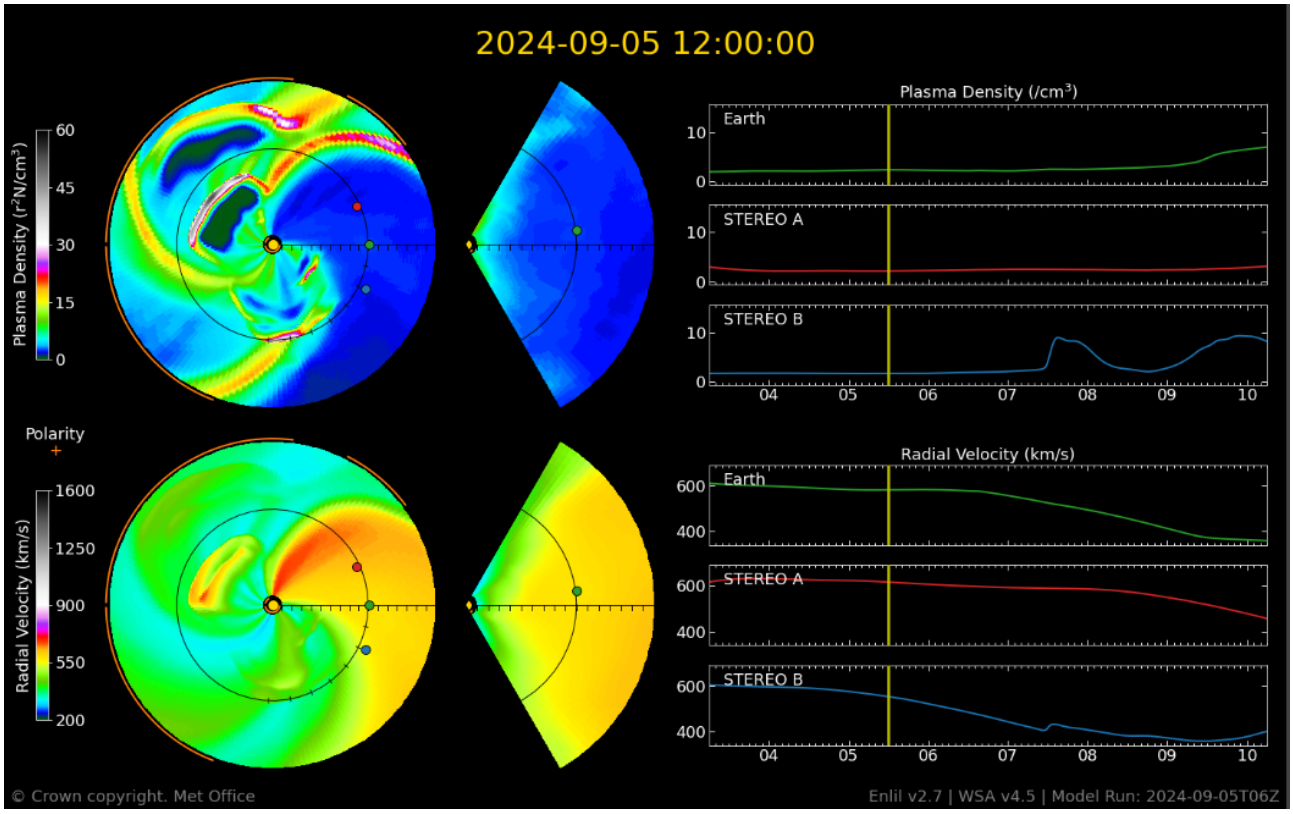
Geomagnetic Activity - Earthbound Coronal Mass Ejections

No Earth directed CMEs currently expected.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Figure 2: MOSWOC Enlil, which is significantly overestimating the current solar wind speed. Otherwise, no Earth directed CMEs are currently expected.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

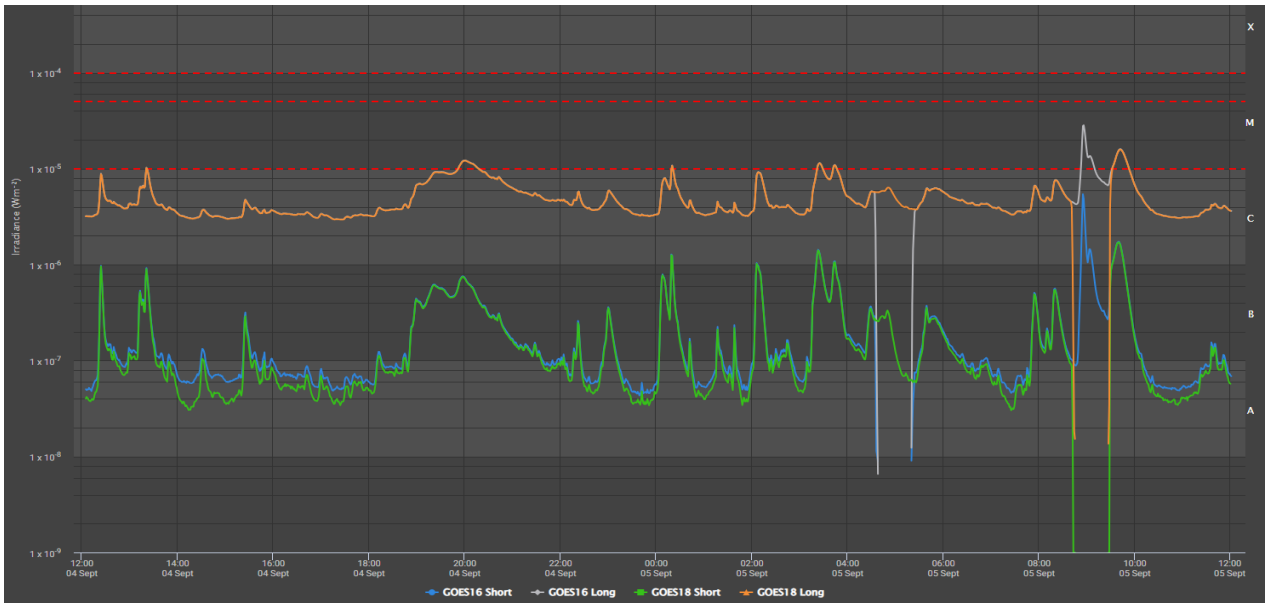
© Crown Copyright 2024. All Rights Reserved.

Radio Blackouts - X-Ray Flares:
There are currently seven sunspot regions on the visible disc. AR3806 in the southwest is the largest and most complex region on the disc, with a large number of mostly small spots, including a couple of small delta spots. It is now starting to merge with AR3808 behind, however. AR3807 is now rotating off the southwest limb, so it is now becoming impossible to analyse but there are hints of growth. AR3813 in the southeast appears to have a fairly straightforward magnetic structure, as does the unnumbered region following it, although this is still suffering from foreshortening near the limb which makes it difficult to classify. AR3811 also appears relatively simple magnetically. Remaining regions are smaller and mostly stable.

Activity has been Moderate over the past 24 hours with a number of low level M-flares, peaking at M2.8 at 05/0856 UTC from AR3807 on the west limb. Further M-class flares are expected with a chance of isolated X-class flares. AR3807 is expected to rotate off the disc early on Day 2 (06 Sep), with the flare risk from this region slowly easing over the following 24 hours. Whilst further regions are due to rotate onto the disc during this period, there is currently little evidence of significant regions arriving over the east limb. As such the probability drops slightly on Days 3 and 4 (07-08 Sep) after AR3807 rotates off.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	80	80	70	70
Very Active	R3 to R5 X Class	No	25	25	20	20

Figure 3: X-ray flux at GOES16 and 18, showing several low level M-flares in the last 24 hours.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

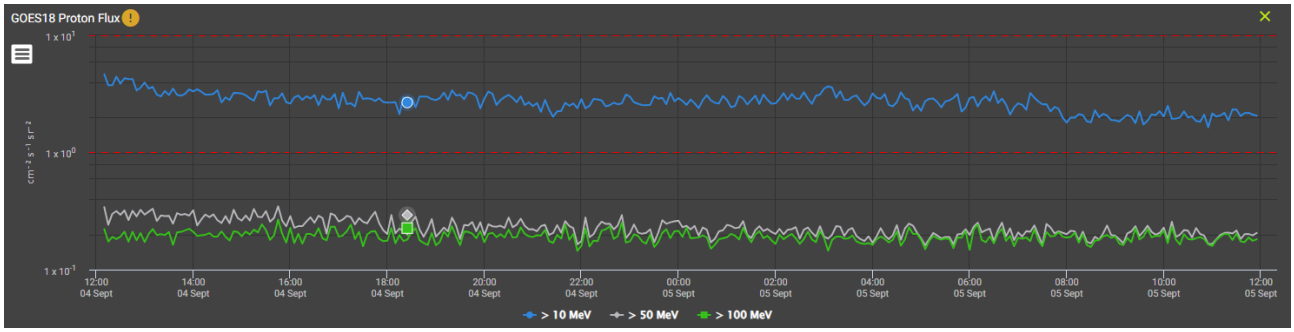
© Crown Copyright 2024. All Rights Reserved.

Solar Radiation Storms - (High Energy Protons):
High energy proton flux, as observed by GOES-18, is above background levels but slowly easing in response to the large eruption and associated M5.5 flare off the southeast limb on 01 Sep. However, it is considered unlikely to reach the S1/Minor Radiation Storm threshold at this time, in the absence of further notable flares.

There are several regions on the disc which could give an increase in proton flux, should they produce larger flares, including AR3807 and AR3806 in the western hemisphere. Ordinarily, AR3813 would be considered a low risk of exceeding S1 from its current location in the southeast quadrant, but given it has already produced a proton response at Earth from closer to the east limb, this region will pose an increasing risk of radiation storms as it rotates westward. Overall, there is a slight but increasing chance of reaching the S1 threshold in the coming days, should there be any larger flares from any of the aforementioned regions.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	20	20	25	25
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: Proton flux at GOES18, which is above background levels but below the S1/Minor Radiation Storm threshold.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

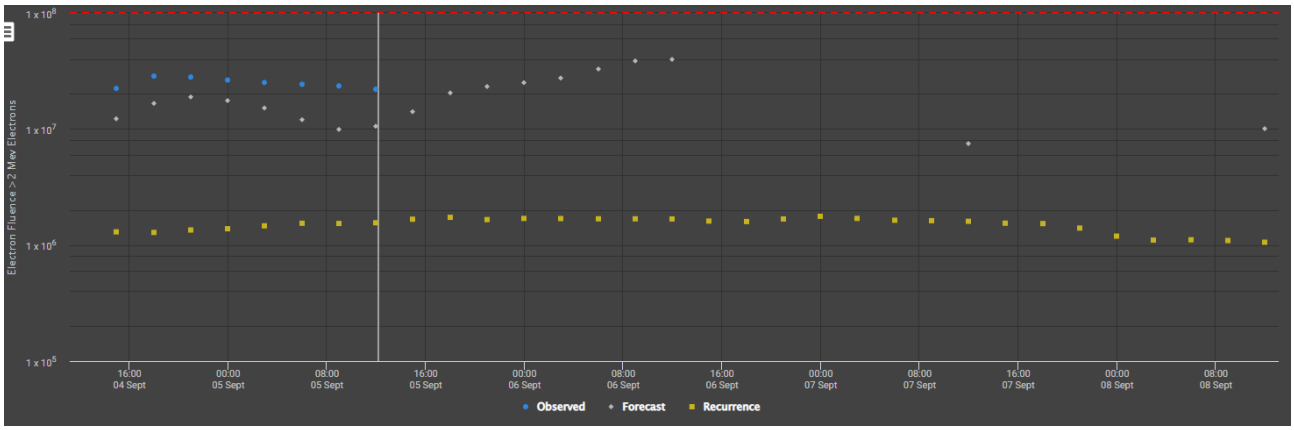
© Crown Copyright 2024. All Rights Reserved.

High Energy Electrons Event (≥ 2MeV):
High energy electron flux as observed by GOES-16 briefly reached high levels at the diurnal maximum yesterday. The CME arrival on 04 Sep only caused a limited geomagnetic response. As such, this feature is unlikely to have driven a significant increase in electron flux and may even have caused a dropout in the electron flux at GEO. Any HSS from CH65 may drive more of an increase in the electron flux, perhaps briefly reaching high levels at the end of the period.

Overall, the 24 hour fluence is likely to remain below the Active (1e8 integrated pfu) threshold for much of this period, perhaps with a rising trend later after any HSS from CH65 starts to ease. Therefore, there is a slight chance of exceeding the Active threshold by the end of the period. MOSWOC REFM is showing the most likely forecast, below Active, but will not be taking into account the upcoming potential HSS.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	1	1	10	20
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 5: MOSWOC REFM, showing a below Active forecast, which is the most likely outcome.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.